Hydrological summary *for the United Kingdom*

December 2001

General

December was a cold and, in most regions, a very sunny month as high pressure extended westwards from the continent greatly restricting incursions of rain-bearing Atlantic frontal systems. Significant snowfall was experienced, in northern Britain particularly, but generally monthly precipitation totals were very modest. A protracted dry interlude- extending beyond 11 weeks by early January - has produced a transformation in hydrological conditions. The widespread vulnerability to flooding in October has been superseded by notably low late-2001 river flows and a deterioration in the water resources outlook. This is particularly true in parts of the South-West and Northern Ireland where depressed winter stocks characterise some smaller reservoirs. However, reservoir stocks (for E&W) are still marginally above average and groundwater resources – parts of the western Chalk excepted - still show the benefit of the extraordinarily high recharge over the winter of 2000/01. Overall water resources remain healthy, but substantial late-winter rainfall would be particularly welcome in western areas dependent on surface water resources.

Rainfall

The month began in unsettled vein with significant rainfall across much of the UK, in the west and north particularly; Sloy (Western Scotland) reported 42 mm on the 3rd and Ballypatrick Forest (NI) 37 mm on the 4/5th. Thereafter, many areas experienced a wide variety of precipitation types – rain, sleet, snow, fog-drip, but the intermittently damp complexion to the weather (in the east especially) did not translate into significant precipitation totals. A few southern areas reported only around a tenth of the normal rainfall over the five weeks beginning on the 5th December. Above average rainfall for December was largely restricted to northern Scotland, especially the North-East where snow was plentiful. The great majority of southern Britain registered less than half the average monthly rainfall with many central southern areas reporting only around 30%. Provisional data indicate that the UK rainfall total for Nov/Dec is among the three lowest since 1945 (1975 and 1988 are the others). Rainfall deficiencies in the west extend over a considerably longer timespan. In parts of the South-West rainfall was below 70% of average for the May-December period; in some catchments the driest such sequence since at least 1975. Annual rainfall totals for 2001 are also appreciably below average in the west. Provisional data suggest that Northern Ireland registered its third driest year in a series from 1900; parts of western Scotland were notably dry also. By contrast, large parts of the English lowlands registered their fourth successive year with well above average rainfall.

River Flows

River flows, which were mostly well above average in October, declined in November and - despite an upturn in early December - steep recessions were soon re-established. With catchments frozen, flows in impermeable areas approached late-December minima in many rivers including the Tay, Nith, Annacloy, Mole and Taw. With few exceptions (e.g. the Leven), December mean flows were well below average – typically in the 50-70% range - and especially depressed in responsive western and northern catchments. The Kenwyn registered its second lowest December runoff in a record from 1965. More significantly, runoff for the last two months is well below the previous Nov/Dec minimum; the same is true of the Annacloy in Northern Ireland. Modest May-December runoff totals characterise many western rivers whereas in permeable catchments across much of England, significant baseflow contributions have counterbalanced the limited recent rainfall - December flows were mostly well within the normal range. 2001 runoff totals for rivers in western Scotland (where the Luss established a new annual minimum) and NI were significantly below average. Generally however, annual runoff totals are well above average and rivers establishing record annual runoff totals show a wide distribution across the English lowlands – including the Lea which has a flow record from 1879.

Groundwater

Soil moisture deficits remained close to zero throughout December but the limited rainfall – which was particularly low across southern aquifer outcrop areas – resulted in very low monthly infiltration totals. As a consequence, the seasonal recovery in groundwater levels (and spring outflows) remains tentative; levels remain similar to those of the late summer in parts of the Chalk. However, the 2001 seasonal recovery began from exceptionally high levels in most outcrop areas – a legacy of the remarkable 2000/01 recharge. The notably low recent infiltration rates have mitigated the threat of groundwater flooding, and are of less significance in water resources terms than would be the case with more typical antecedent recharge patterns. December levels in the south-western Chalk outcrops were relatively depressed – albeit well above drought minima – but remain at seasonally high levels throughout most of the slower-responding eastern and northern outcrops. For the first time in 13 successive months, the Stonor well failed to establish a new monthly maxima level (in a 41-year series). Groundwater levels in the limestone aquifers are relatively close to normal for the early winter – but remain high in the Lincolnshire Limestone. Levels in the Permo-Triassic sandstones generally reflect recharge over a number of years and current levels are very healthy in most outcrop areas. Groundwater levels through the spring and summer of 2002 will be heavily influenced by rainfall patterns over the next 10-12 weeks.

Centre for Ecology & Hydrology
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Rainfall accumulations and return period estimates

Area	Rainfall	Dec 2001	Nov01-Dec01	RP	May01-Dec01	RP	Jan01-Dec01	RP	Jan00-Dec01	RP
England & Wales	mm	**43**	**107**		**569**		**953**		**2180**	
	%	**45**	**57**	**10-20**	**91**	**2-5**	**104**	**2-5**	**119**	**35-50**
North West	mm	70	162		726		1081		2657	
	%	57	66	5-10	87	2-5	90	2-5	111	5-10
Northumbrian	mm	63	124		526		807		1877	
	%	78	74	2-5	90	2-5	95	2-5	110	5-10
Severn Trent	mm	34	83		488		767		1749	
	%	44	56	5-15	95	2-5	102	2-5	116	10-20
Yorkshire	mm	47	94		505		787		1866	
	%	56	58	5-15	91	2-5	96	2-5	114	5-15
Anglian	mm	25	74		458		731		1495	
	%	46	66	5-10	110	2-5	123	10-20	125	80-120
Thames	mm	25	67		448		779		1714	
	%	35	50	10-20	94	2-5	113	2-5	124	40-60
Southern	mm	28	68		463		865		1978	
	%	34	41	20-30	87	2-5	111	2-5	127	70-100
Wessex	mm	31	82		458		825		1948	
	%	33	47	10-20	81	5-10	98	2-5	116	5-15
South West	mm	53	149		555		1008		2401	
	%	38	56	5-15	72	10-20	86	5-10	102	2-5
Welsh	mm	69	195		796		1250		2934	
	%	45	66	5-10	90	2-5	95	2-5	112	5-10
Scotland	mm	**103**	**236**		**865**		**1196**		**2785**	
	%	**68**	**78**	**5-10**	**88**	**5-10**	**83**	**10-20**	**97**	**2-5**
Highland	mm	148	335		1090		1444		3371	
	%	75	84	2-5	91	2-5	82	10-20	96	2-5
North East	mm	81	158		651		945		2135	
	%	87	82	2-5	97	2-5	97	2-5	110	5-10
Tay	mm	64	148		726		1100		2593	
	%	50	60	5-15	89	2-5	89	2-5	105	2-5
Forth	mm	55	137		631		936		2265	
	%	50	62	5-15	83	5-10	84	5-15	102	2-5
Tweed	mm	56	123		573		864		2049	
	%	60	66	5-10	86	5-10	89	2-5	106	2-5
Solway	mm	76	188		792		1168		2972	
	%	51	64	5-10	82	5-10	82	10-20	105	2-5
Clyde	mm	99	262		1006		1399		3321	
	%	55	73	5-10	87	5-10	82	10-20	98	2-5
Northern Ireland	mm	**77**	**145**		**574**		**842**		**2046**	
	%	**74**	**70**	**5-10**	**80**	**5-10**	**80**	**10-20**	**97**	**2-5**

RP = Return period

 All monthly totals since December 1998 are provisional (see page 12). The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used to derive the CRU data series. The return period estimates are based on tables provided by the Meteorological Office (see Tabony, R.C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37) and relate to the specified span of months only (return periods may be up to an order of magnitude less if n-month periods beginning in any month are considered); RP estimates for Northern Ireland are based on the tables for north-west England. The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts, in the Scottish rainfall series in particular, can exaggerate the relative wetness of the recent past. * See page 12.

Rainfall . . . Rainfall . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

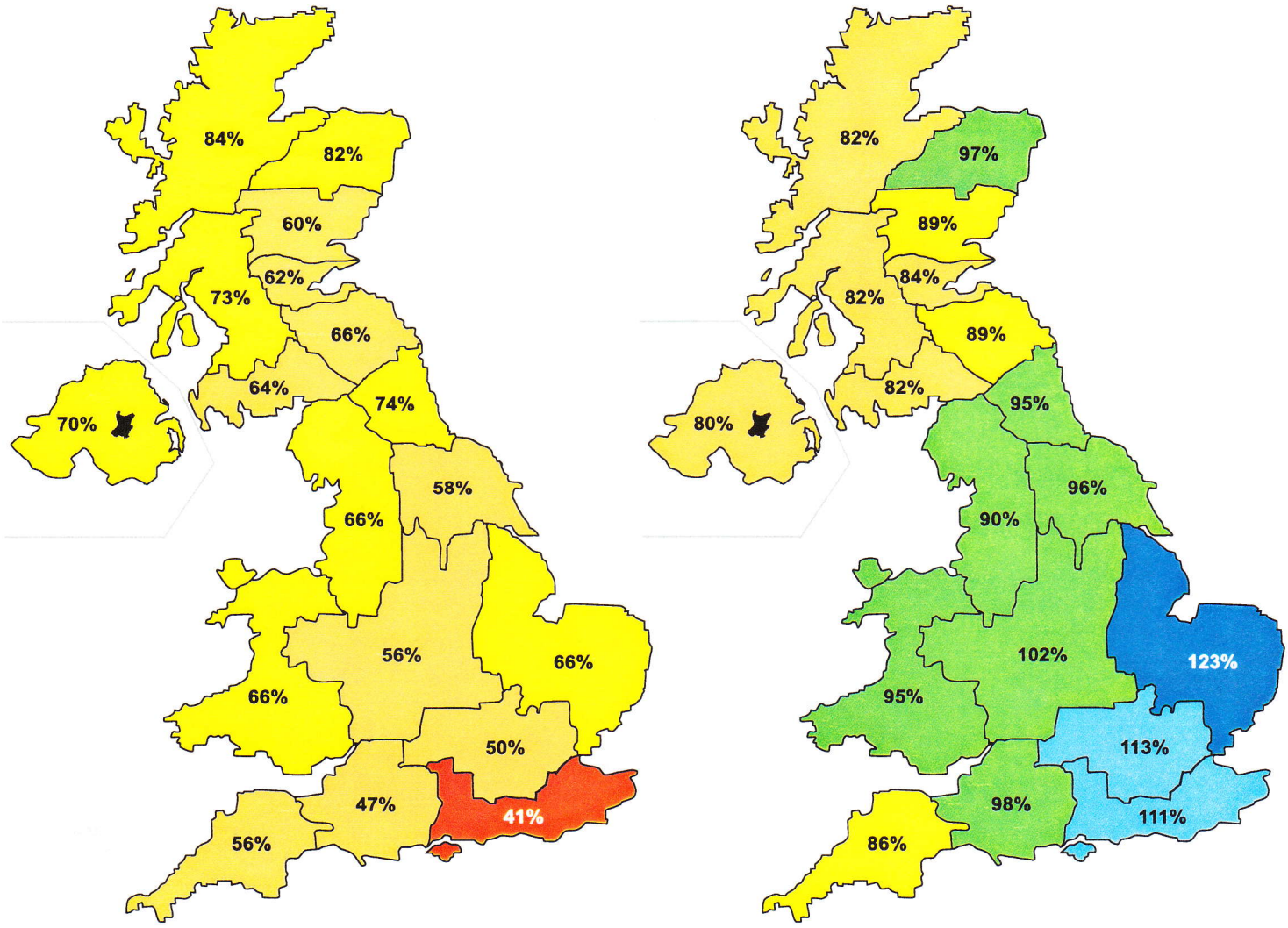
Above average

Normal range

Below average

Substantially below average

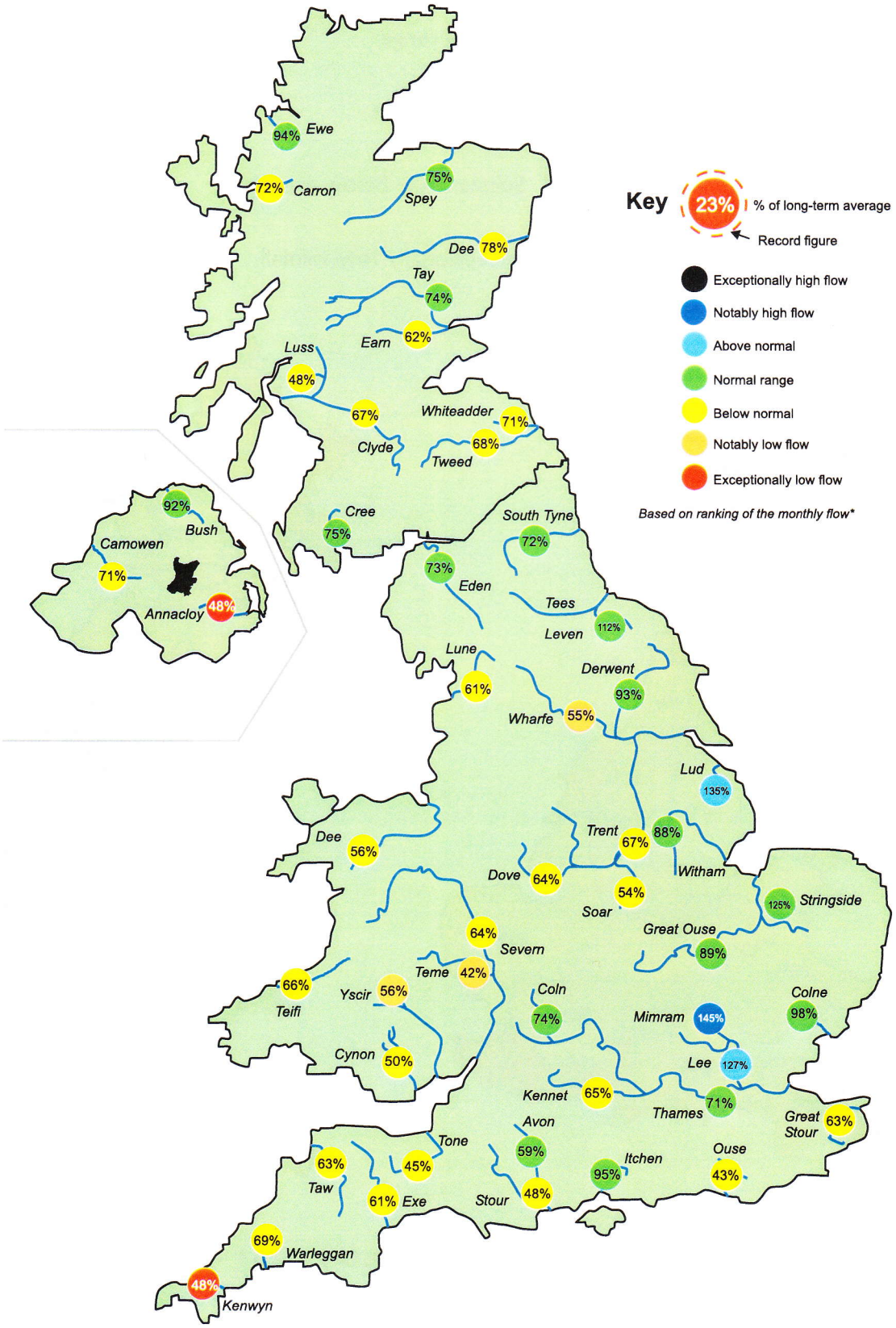
Exceptionally low rainfall



November 2001 -December 2001 **January 2001 -December 2001**

Rainfall accumulation maps

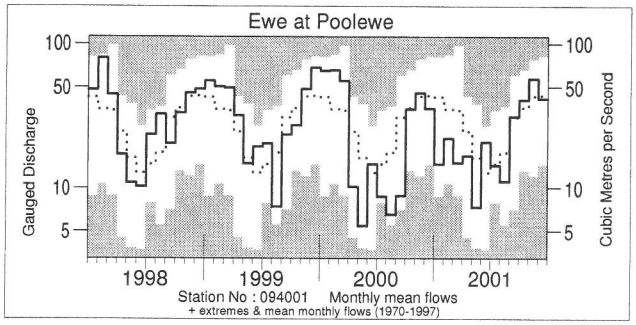
The combined November and December rainfall was the second lowest for England and Wales since 1953; many southern areas were exceptionally dry. Despite the dry end to 2001, provisional annual rainfall totals are within 20% of the 1961-90 average for all regions except Anglian which was notably wet. Longer term rainfall accumulations remain exceptional high across most of southern Britain – and are reflected in the relative health of current groundwater resources.

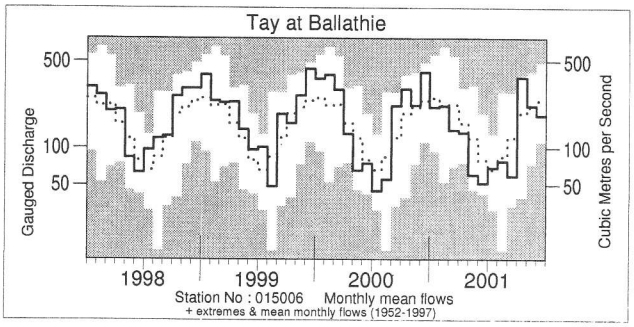


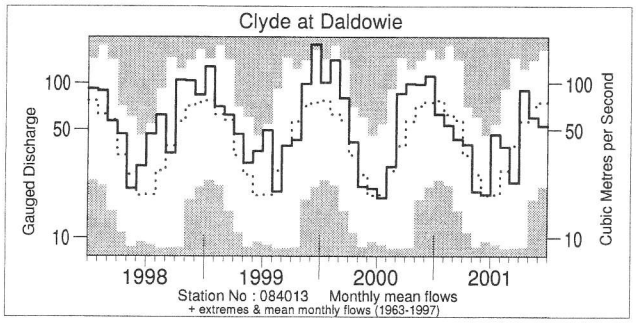
River flows - December 2001

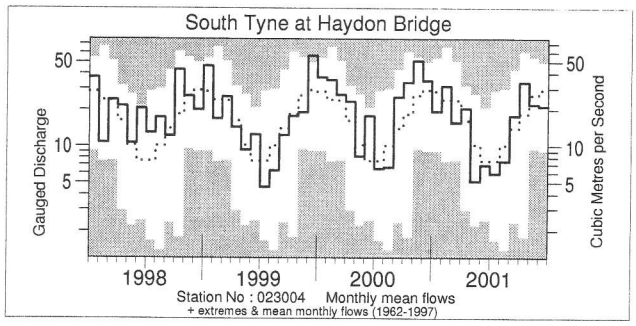
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station.

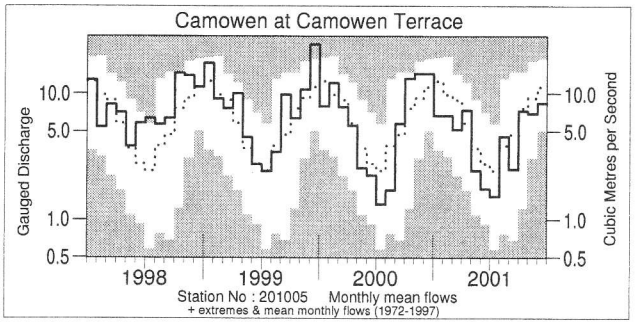
River flow . . . River flow . . .

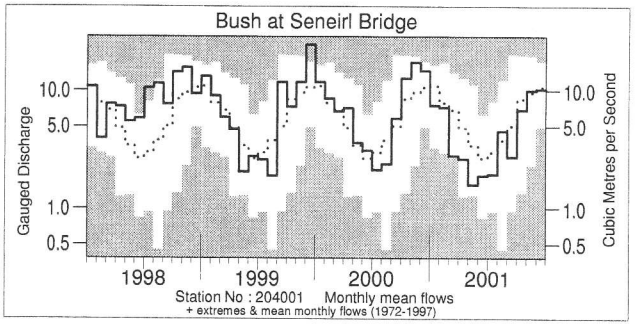


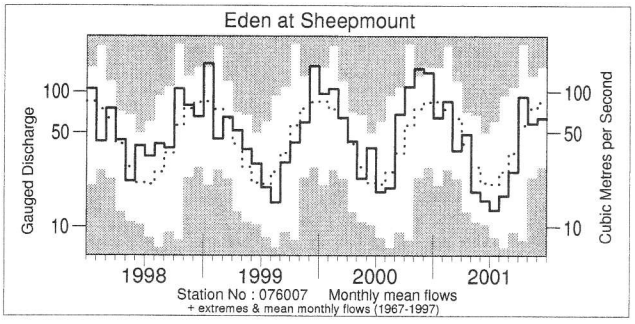


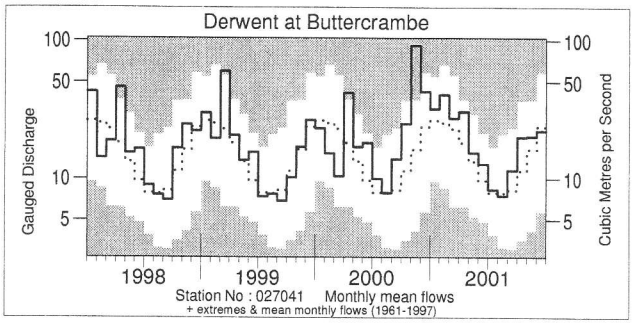


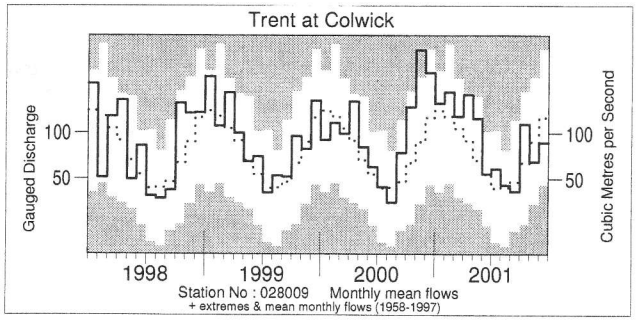


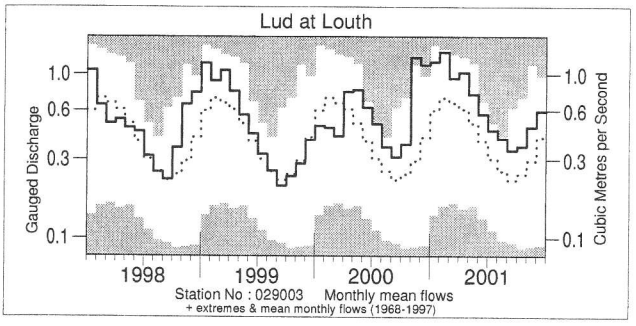








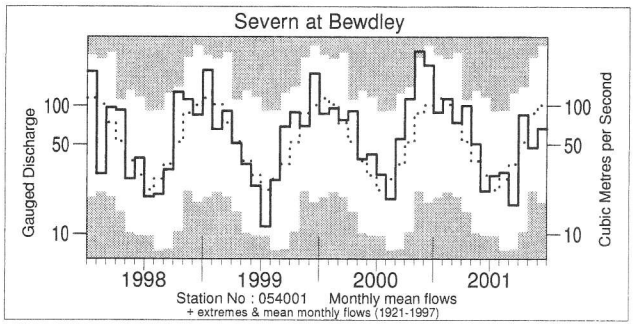


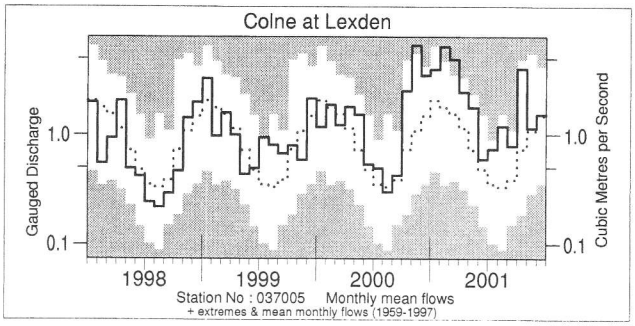


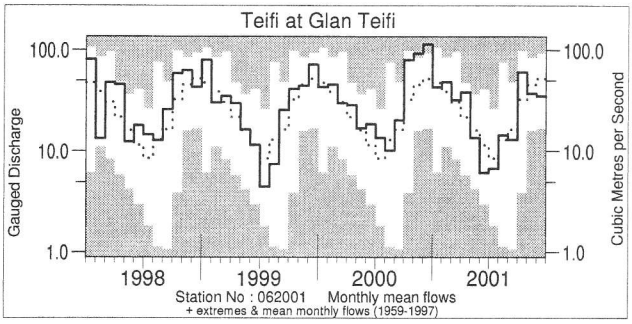
Monthly river flow hydrographs

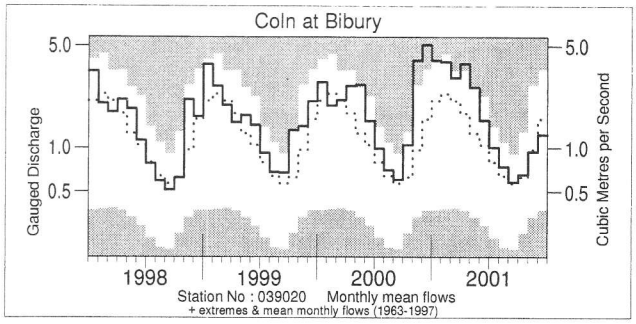
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1998 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

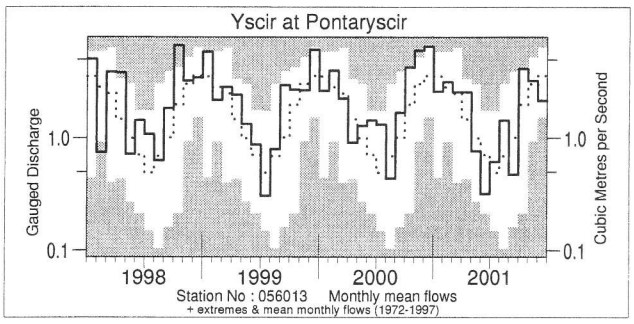
River flow . . . River flow . . .

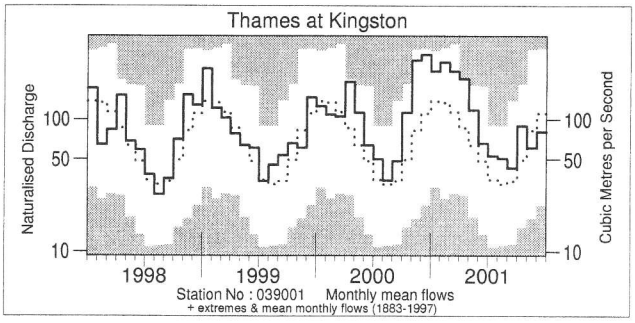


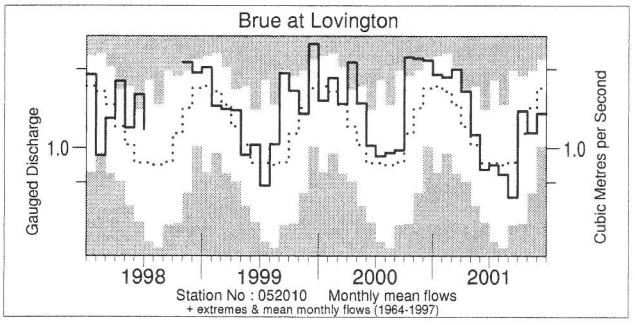


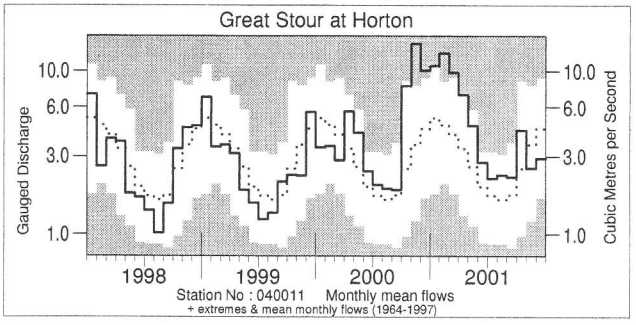


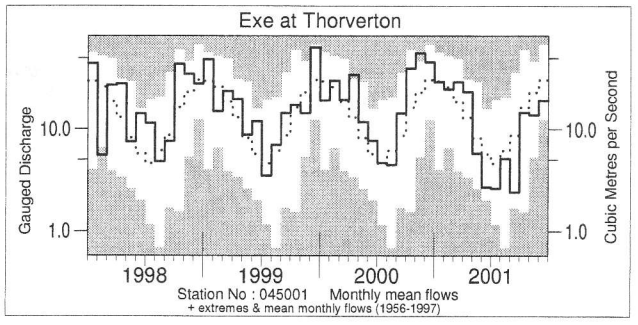


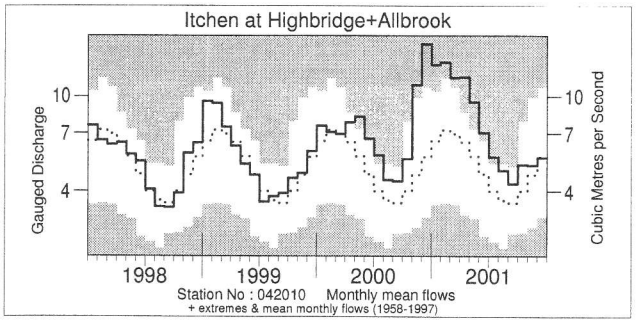












Notable runoff accumulations (a) November2001 - December 2001, (b) January 2001 - December 2001

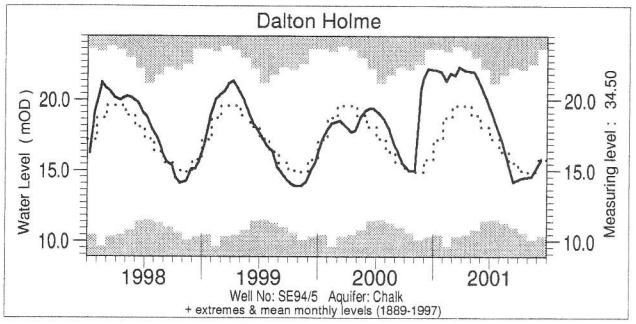
	River	%lta	Rank
(a)	Whiteadder	72	10/33
	Mimram	153	45/48
	Kenwyn	41	1/34
	Dee (Welsh)	75	7/33
	Luss	57	3/23
	Annacloy	37	1/22

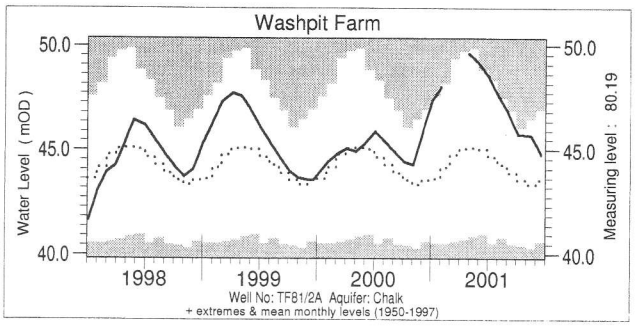
	River	%lta	Rank
(b)	Lud	157	33/33
	Witham	181	42/42
	Stringside	183	33/33
	Colne	230	41/41
	Lee	225	115/115
	Mimram	220	48/48
	Blackwater	170	49/49

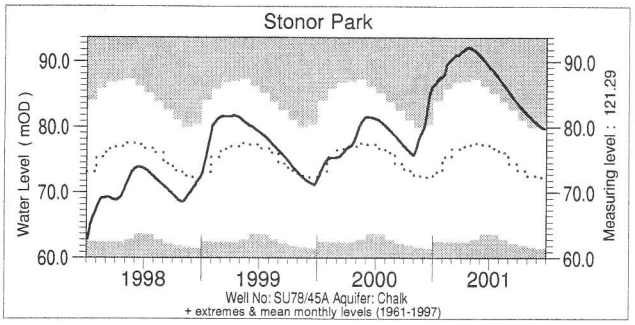
River	%lta	Rank
Lambourn	171	39/39
Great Stour	165	35/35
Test	148	42/42
Itchen	152	43/43
Cree	79	3/38
Luss	71	1/23
Camowen	73	2/28

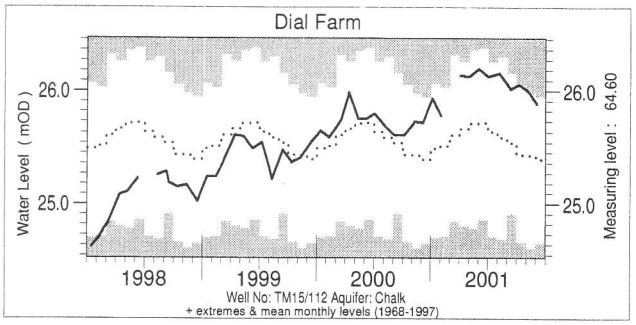
lta = long term average
Rank 1 = lowest on record

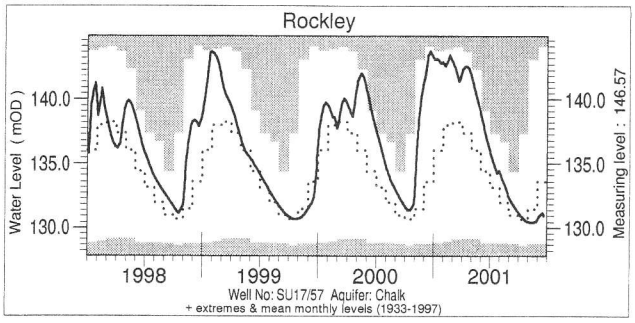
Groundwater . . . Groundwater

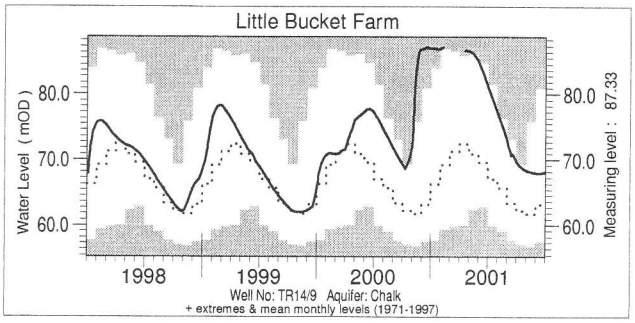


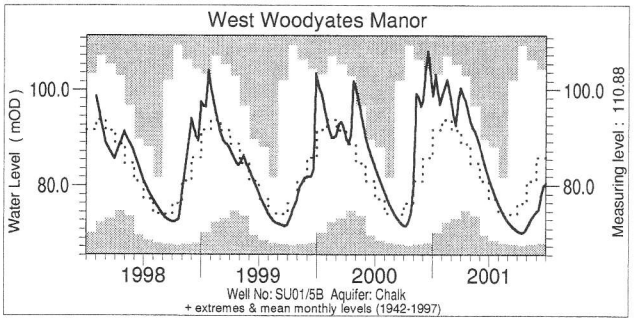


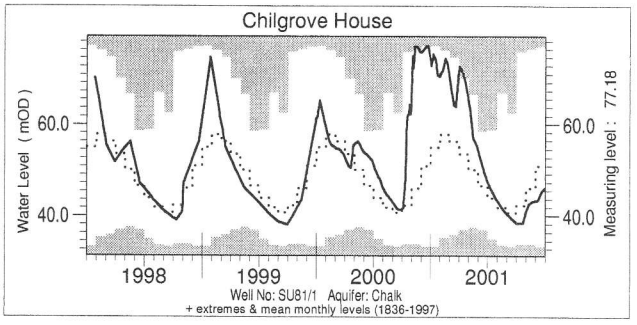


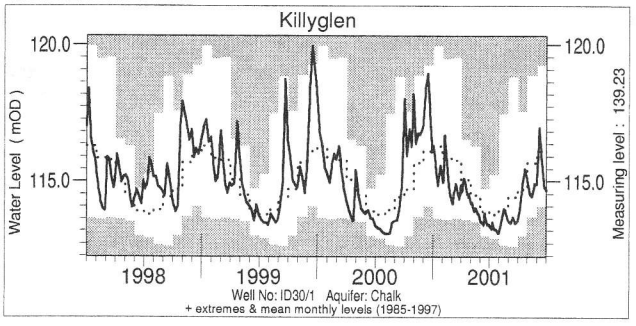


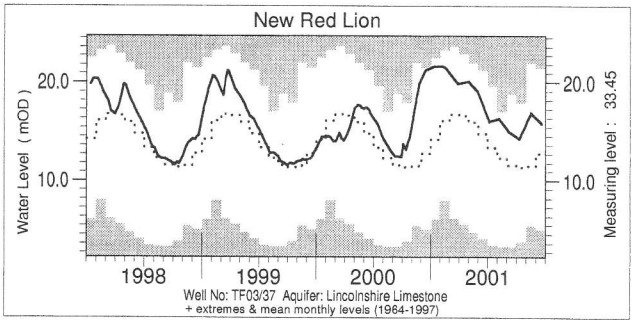








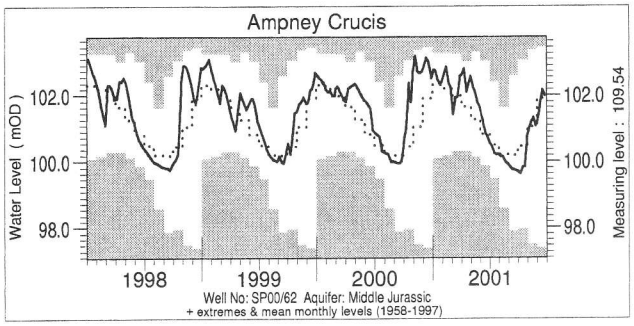


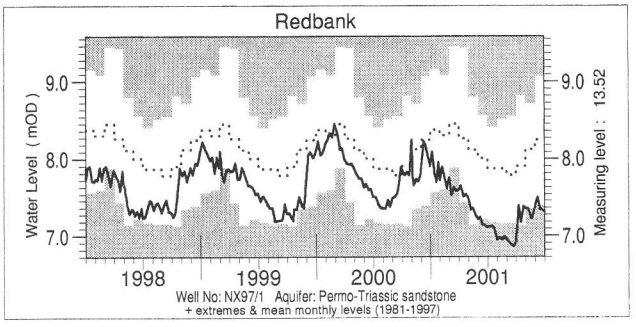


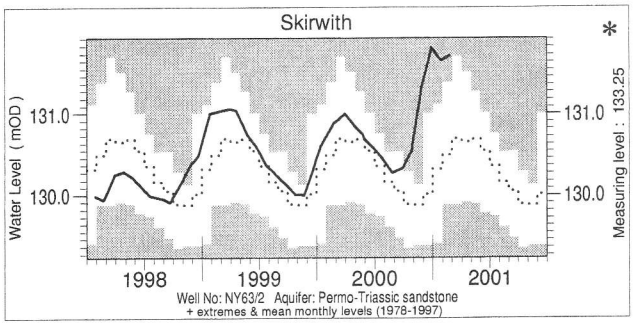
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly max., min. and mean levels are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously – the latest recorded levels are listed overleaf.

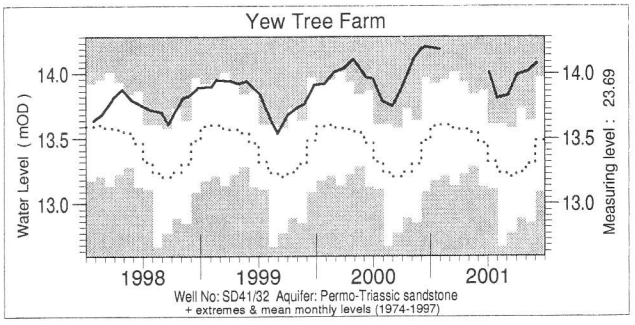
* No March - December groundwater levels available.

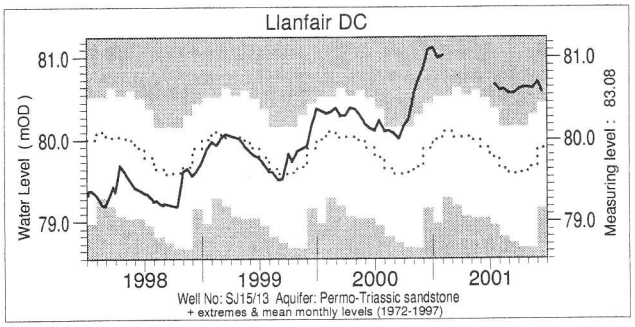
Groundwater . . . Groundwater

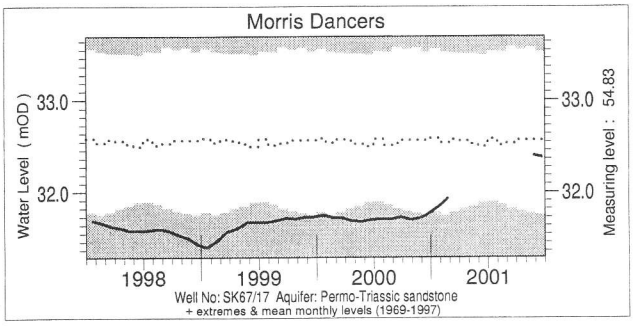


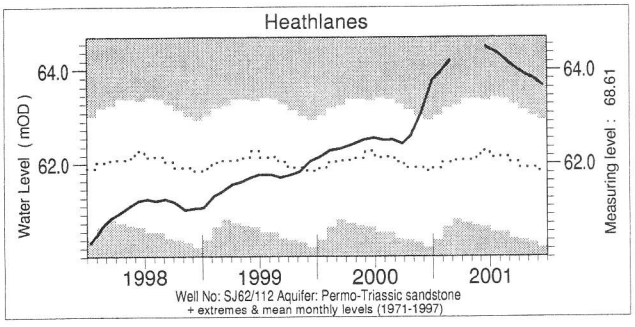


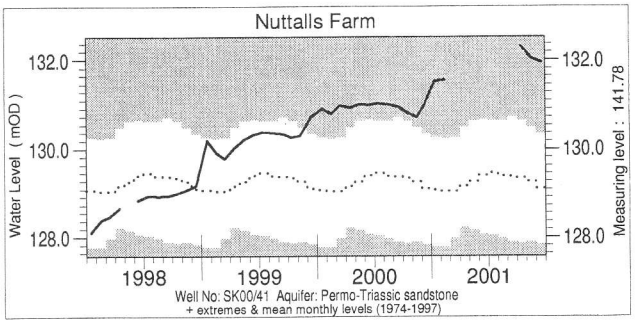


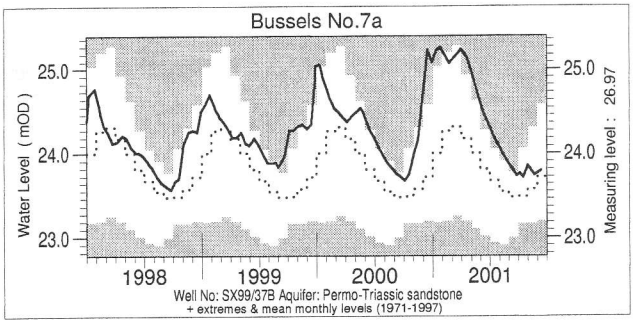


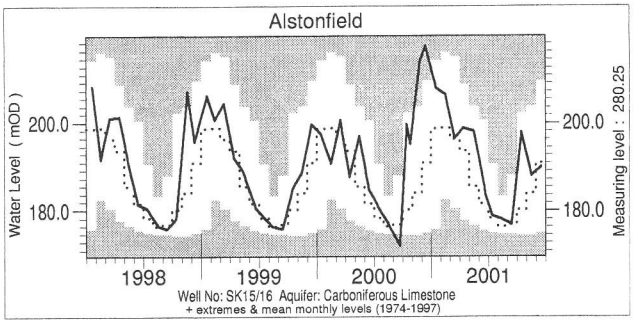








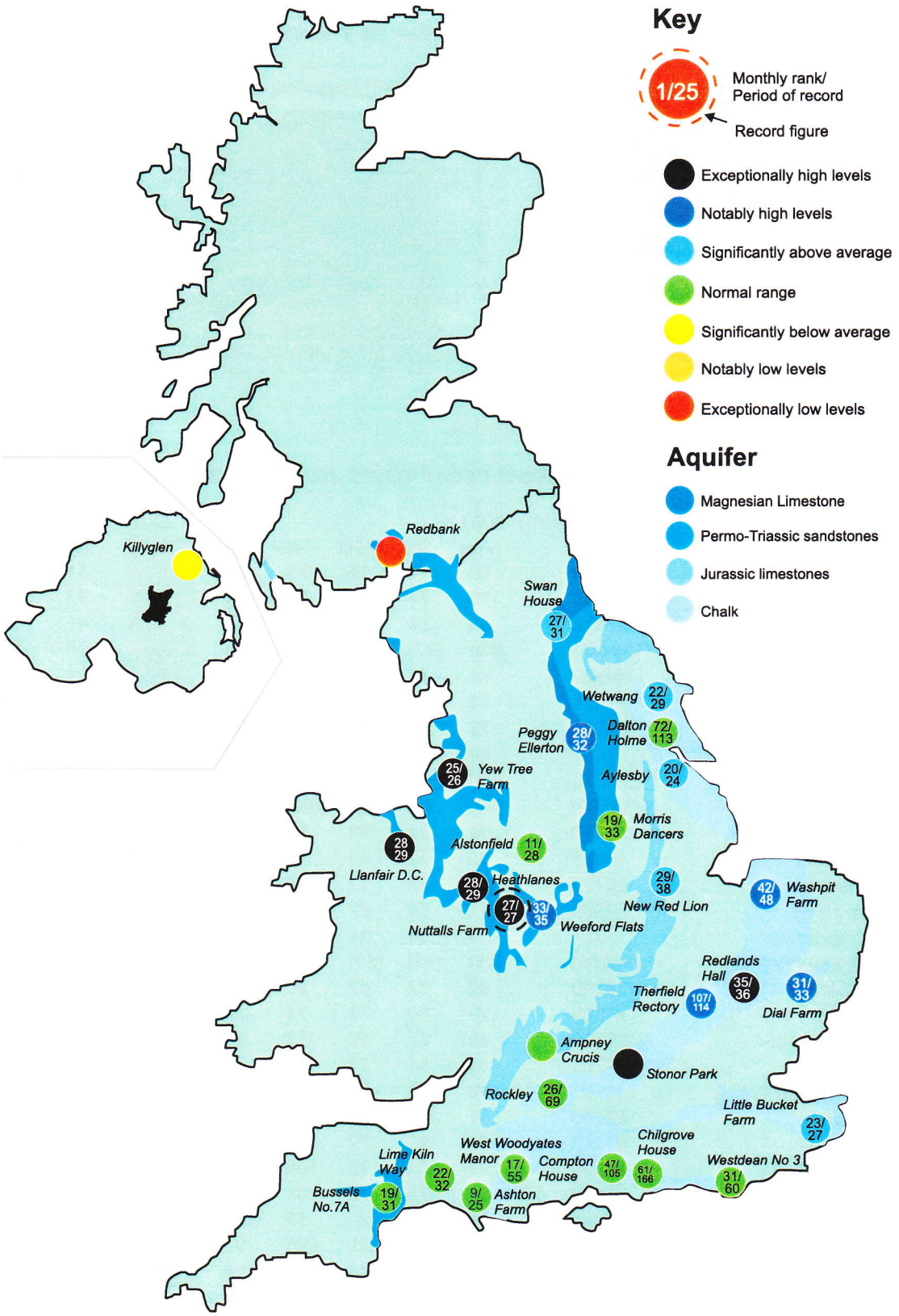




Groundwater levels December 2001 / January 2002

Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.
Dalton Holme	15.80	13/12	15.59	Chilgrove House	45.97	29/12	51.98	Morris Dancers	32.38	21/12	32.41
Washpit Farm	44.79	17/12	43.30	Killyglen	114.66	31/12	116.35	Heathlanes	63.67	17/12	61.86
Stonor Park	79.54	07/01	72.57	New Red Lion	15.85	18/12	12.70	Nuttalls Farm	131.94	19/12	129.34
Dial Farm	25.89	03/12	25.39	Ampney Crucis	101.39	07/01	101.90	Bussels No.7a	23.79	12/12	23.83
Rockley	131.44	02/01	133.77	Redbank	7.26	08/01	8.20	Alstonfield	189.98	17/12	192.64
Little Bucket Farm	68.17	31/12	64.66	Yew Tree Farm	14.13	07/01	13.53	Data missing due to Foot & Mouth restrictions			
West Woodyates	80.55	31/12	86.87	Llanfair DC	80.58	01/01	79.82	*Levels in metres above Ordnance Datum*			

Groundwater . . . Groundwater

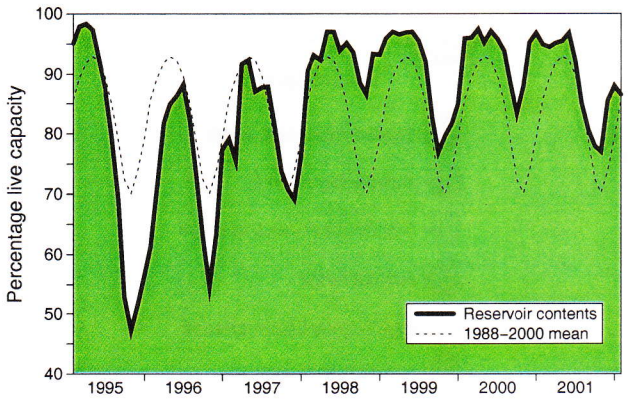


Groundwater levels - December 2001

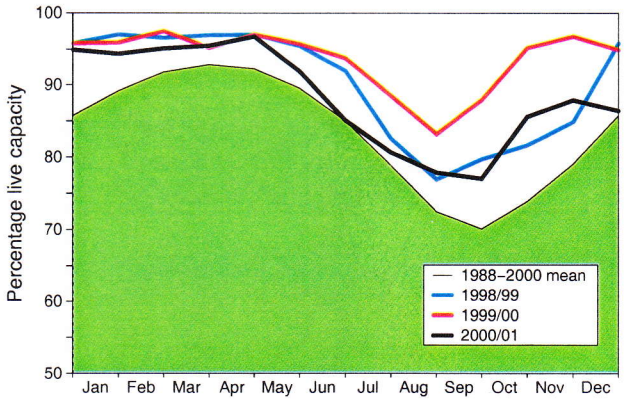
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

(Note: Redbank is affected by groundwater abstraction)

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2001 Aug	Sep	Oct	Nov	Dec	2002 Jan	Min. Jan	Year* of min
North West	N Command Zone	• 124929	50	44	44	75	84	84	51	1996
	Vyrnwy	55146	79	74	71	86	91	88	35	1996
Northumbrian	Teesdale	• 87936	65	57	63	96	83	84	41	1996
	Kielder	(199175)	(89)	(87)	(86)	(80)	(95)	(89)	70	1990
Severn Trent	Clywedog	44922	61	46	49	73	100	87	54	1996
	Derwent Valley	• 39525	71	69	81	99	86	100	10	1996
Yorkshire	Washburn	• 22035	75	69	69	89	92	91	23	1996
	Bradford supply	• 41407	64	61	64	86	90	90	22	1996
Anglian	Grafham	(55490)	(94)	(95)	(95)	(93)	(88)	(88)	57	1998
	Rutland	(116580)	(85)	(80)	(78)	(80)	(81)	(82)	60	1991
Thames	London	• 202340	91	91	90	90	87	86	60	1991
	Farmoor	• 13830	96	92	94	92	91	77	71	1991
Southern	Bewl	28170	85	79	72	74	74	75	38	1991
	Ardingly	4685	91	70	67	72	73	86	61	1990
Wessex	Clatworthy	5364	64	54	44	67	72	84	59	1989
	Bristol WW	• (38666)	(75)	(69)	(60)	(61)	(59)	(61)	40	1991
South West	Colliford	28540	82	72	62	60	62	64	46	1996
	Roadford	34500	85	80	73	73	73	72	23	1996
	Wimbleball	21320	69	61	50	52	54	58	46	1996
	Stithians	5205	66	51	37	32	29	33	33	2002
Welsh	Celyn and Brenig	• 131155	96	92	92	94	97	94	54	1996
	Brianne	62140	81	86	86	100	100	94	76	1996
	Big Five	• 69762	78	82	77	97	95	93	67	1996
	Elan Valley	• 99106	87	93	93	100	100	99	56	1996
East of Scotland	Edinburgh/Mid Lothian	• 97639	80	75	70	89	90	89	60	1999
	East Lothian	• 10206	91	90	84	97	100	100	48	1990
West of Scotland	Loch Katrine	• 111363	57	58	55	85	93	88	80	1996
	Daer	22412	64	55	48	91	100	97	83	1996
	Loch Thom	• 11840	66	66	62	84	93	93	93	2002
Northern Ireland	Silent Valley	• 20634	59	59	47	54	43	39	39	2002

() figures in parentheses relate to gross storage • denotes reservoir groups * last occurrence - see footnote

Details of the individual reservoirs in each of the groupings listed above are available on request. The featured reservoirs may not be representative of the storage conditions across each region; this can be particularly important during droughts. The minimum storage figures relate to the 1988-2002 period only (except for West of Scotland and Northern Ireland where data commence in 1994 and 1993 respectively). In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

Location map . . . Location map

National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology - IH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department of the Environment, Transport and the Regions, the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

River flow and groundwater level data are provided by the regional divisions of the EA (England and Wales) and SEPA (Scotland), data for Northern Ireland are provided by the Rivers Agency and the Department of the Environment (NI). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

Reservoir level information is provided by the Water Service Companies, the EA, the West of Scotland and East of Scotland Water Authorities, and the Northern Ireland Water Service.

The National River Flow Archive (maintained by CEH Wallingford) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Rainfall

Most rainfall data are provided by The Met Office (address opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of The Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS*. Recent figures have been produced by The Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. An initiative is underway with The Met Office to provide more accurate areal figures and, since October 1999, to include more raingauges in the analysis. A significant number of additional monthly rainfall totals are currently being provided by the Environment Agencies; over the coming months further monthly raingauge totals will be included for selected regions. Until the access to these additional data has stabilised the regional figures (and the return periods associated with them) should be regarded as a guide only.

*MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

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Fax: 01344 854906

The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

Hydrological Summaries
National Water Archive
CEH Wallingford
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
Tel.: 01491 838800
Fax: 01491 692424

Selected text and maps are available on the WWW at
http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

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12/01